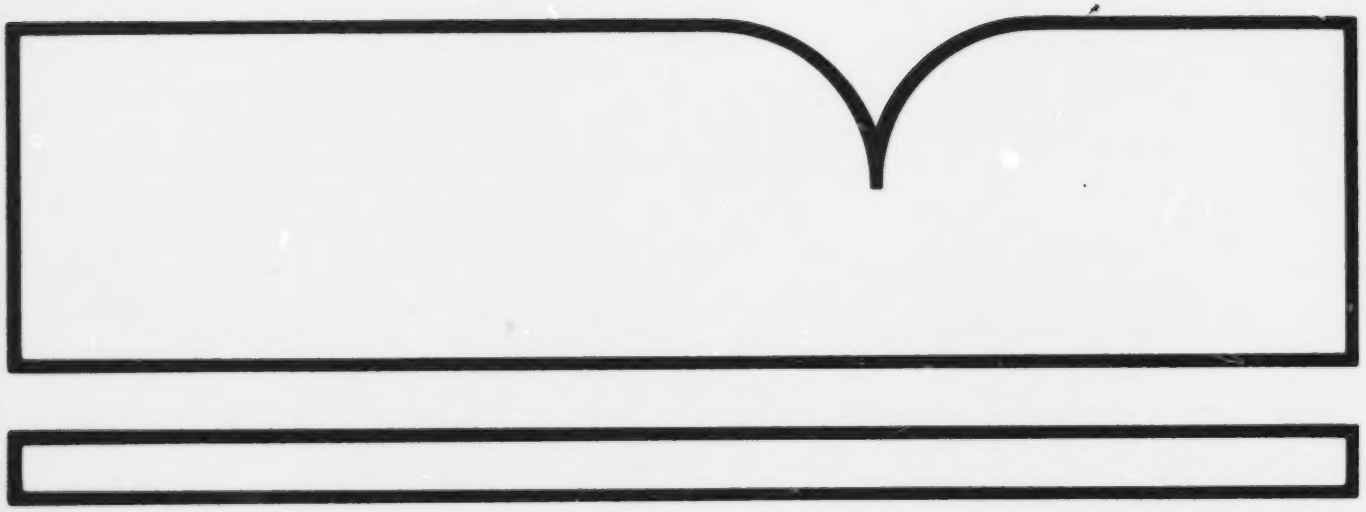
PB90-166281

Proposed Best Demonstrated Available Technology (BDAT) Background Document for P and U Thallium Wastes. Volume 17

(U.S.) Environmental Protection Agency, Washington, DC

Nov 89



U.S. Department of Commerce
National Technical Information Service
NTIS

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/530-SW-90-011Q	2.	3. PB90-166281
4. Title and Subtitle PROPOSED BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR P AND U THALLIUM WASTES (3RD 3RDS)			5. Report Date NOVEMBER 1989 6.
7. Author(s) ROSENGRANT/CHATMON			8. Performing Organization Rept. No
9. Performing Organization Name and Address U.S. EPA Office of Solid Waste 401 M. Street SW Washington, DC 20460			10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered BACKGROUND DOCU. - 11/89 14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This background document presents the Agency's technical support and rationale for developing regulatory standards for these wastes. Sections 2 through 7 present waste-specific information for hte thallium-containing wastes.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
RELEASE UNLIMITED	UNCLASSIFIED	0
	20. Security Class (This Page) UNCLASSIFIED	22. Price 0

(See ANSI-Z39.18)

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)

EPA/530-SW-90-011Q

PROPOSED
BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)
BACKGROUND DOCUMENT FOR P AND U THALLIUM WASTES

U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Larry Rosengrant, Chief
Treatment Technology Section

Monica Chatmon-McEaddy
Project Manager

November 11, 1989

Table of Contents

		Page No.
1.	INTRODUCTION	1-1
2.	INDUSTRIES AFFECTED AND WASTE CHARACTERIZATION	2-1
	2.1 Industries Affected and Process Descriptions	2-1
	2.2 Waste Characterization	2-2
	2.3 Determination of Waste Treatability Groups	2-3
3.	APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES	3-1
	3.1 Applicable Treatment Technologies	3-1
	3.1.1 Treatment Technologies for Nonwastewaters	3-1
	3.1.2 Treatment Technologies for Wastewaters	3-3
	3.2 Demonstrated Treatment Technologies	3-3
4.	PERFORMANCE DATA BASE	4-1
5.	IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)	5-1
6.	DEVELOPMENT OF BDAT TREATMENT STANDARDS	6-1
7.	REFERENCES	7-1

List of Tables

Table 1-1 Proposed BDAT Treatment Standards for P113, P114, P115, U214, U215, U216, and U217 Nonwastewaters ... 1-3

Table 1-2 Proposed BDAT Treatment Standards for P113, P114, P115, U214, U215, U216, and U217 Wastewaters 1-4

Table 2-1 Current Manufacturers of Thallium Compounds 2-4

Table 2-2 Estimated Quantities of RCRA P-Code and U-Code Thallium Wastes Wastes Generated in 1986 2-5

Table 2-3 Estimated Quantities Of RCRA P-Code and U-Code Thallium Wastes Received by TSDR Facilities in 1986. 2-6

Table 7-1 Proposed BDAT Treatment Standards for P113, P114, P115, U214, U215, U216, and U217 Nonwastewaters ... 7-2

Table 7-2 Proposed BDAT Treatment Standards for P113, P114, P115, U214, U215, U216, and U217 Wastewaters 7-3

1. INTRODUCTION

Pursuant to section 3004(m) of the Resource Conservation and Recovery Act (RCRA), as ammended by the Hazardous and Solid Waste Amendments (HSWA), enacted on November 8, 1984, the Environmental Protection Agency (EPA) is proposing treatment standards based on the best demonstrated available technology (BDAT) for U-code and P-code thallium wastes. These wastes are identified in 40 CFR 261.33 as follows:

P113 - Thallic oxide
P114 - Thallium (I) selenite
P115 - Thallium (I) sulfate
U214 - Thallium (I) acetate
U215 - Thallium (I) carbonate
U216 - Thallium (I) chlorate
U217 - Thallium (I) nitrate

Compliance with these treatment standards is a prerequisite for placement of these wastes in facilities designated as land disposal units according to 40 CFR Part 268. The effective data of the final promulgated treatment standards is May 8, 1990.

This background document presents the Agency's technical support and rationale for developing regulatory standards for these wastes. Sections 2 through 7 present waste-specific information for the thallium-containing wastes. Section 2 presents the number and location of facilities affected by the land disposal restrictions, the waste-generating process, and waste characterization data. Section 3 discusses the technologies used to treat the waste (or similar wastes), and Section 4 presents available performance data, including data on which treatment standards are based. Section 5 explains EPA's determination of BDAT, while Section 6 discusses the selection of constituents to be regulated. Proposed treatment standards are determined in Section 7.

The BDAT program and promulgated methodology are more thoroughly described in two additional documents: Methodology for Developing BDAT Treatment Standards (USEPA 1989a) and Generic Quality Assurance Project Plan for Land Disposal Restrictions Program ("BDAT") (USEPA 1988b). The petition process to be followed in requesting a variance from the BDAT treatment standards is discussed in the methodology document.

It is EPA's understanding that only one facility presently manufactures thallium compounds. The wastes generated from production and use of thallium compounds may be either wastewaters or nonwastewaters. A wastewater is defined by the Agency as containing less than 1 percent (weight basis) total suspended solids* and less than 1 percent (weight basis) total organic carbon (TOC). Wastes not meeting this definition must comply with the treatment standards for nonwastewaters.

The proposed BDAT treatment standard for nonwastewater forms of P113, P115, U214, U215, U216, and U217 is recovery or stabilization as a method of treatment. The proposed BDAT treatment standard for P114 nonwastewaters is vitrification or stabilization as a method of treatment. BDAT for the wastewater forms of P113, P114, P115, U214, U215, U216, and U217 is chemical oxidation of thallium (I) compounds followed by chemical precipitation with hydroxide compounds, settling, and filtration. The proposed treatment standard for these wastewaters is 0.14 mg/l, measured at total composition of a 24-hour composite sample. These treatment standards are summarized in Tables 1-1 and 1-2.

---

* The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, the quantity of total suspended solids is measured by Method 209c (Total Suspended Solids Dried at 103 to 105°C) in Standard Methods for the Examination of Water and Wastewater, 16th Edition (APHA, AWWA, and WPCF 1985).

Table 1-1 Proposed BDAT Treatment Standards for P113, P114, P115, U214, U215, U216, and U217 Nonwastewaters

Waste code	Proposed treatment standard
P113, P115, U214, U215, U216, U217	RECOVERY OR STABILIZATION AS A METHOD OF TREATMENT
P114[a]	VITRIFICATION OR STABILIZATION AS A METHOD OF TREATMENT

[a] Also see the Best Demonstrated Available Technology (BDAT) Background Document for K031, K084, K101, K102, characteristic arsenic wastes (D004), characteristic selenium wastes (D010), and P and U wastes containing arsenic and selenium listing constituents (USEPA 1989c) for selenium treatment standard for P114.

Table 1-2 Proposed BDAT Treatment Standards for P113, P114, P115, U214, U215, U216, and U217 Wastewaters

Regulated constituent	Maximum for any single 24-hour composite sample Total composition (mg/l)
Thallium	0.14

[a] Also see the Best Demonstrated Available Technology (BDAT) Background Document for K031, K084, K101, K102, characteristic arsenic wastes (D004), characteristic selenium wastes (D010), and P and U wastes containing arsenic and selenium listing constituents (USEPA 1989c) for selenium treatment standard for P114.

2. INDUSTRIES AFFECTED AND WASTE CHARACTERIZATION

Under 40 CFR 261.33, the thallium-containing hazardous wastes are specifically listed as follows:

P113 - Thallic oxide; Thallium (III) oxide
P114 - Thallium (I) selenite
P115 - Thallium (I) sulfate
U214 - Thallium (I) acetate
U215 - Thallium (I) carbonate
U216 - Thallium (I) chloride
U217 - Thallium (I) nitrate

The Agency has determined that these listed wastes represent a single treatability group based on their similar physical and chemical characteristics. This is because they are all inorganic forms of thallium that generally ionize when dissolved in water. As described later in this section, EPA has examined the sources of the wastes, the specific similarities in the waste composition, applicable and demonstrated treatment technologies, and attainable treatment performance in order to support a simplified regulatory approach for these inorganic wastes.

2.1 Industry Affected and Process Description

According to the 1987 Minerals Yearbook (U.S. Bureau of Mines 1988), only 4,000 pounds of thallium compounds were consumed in the United States in 1987. Thallous bromide (thallium (I) bromide, TlBr) and thallous iodide (thallium (I) iodide, TlI) are used as infrared optical prism and window materials. The other thallium compounds are used primarily for research purposes only. Currently, there is only one manufacturer of thallium salts in the United States. The compounds

presently made are listed in Table 2-1. Other thallium compounds are either imported for use or sold from stockpiles of materials produced at earlier times.

Table 2-1 Current Manufacturers of Thallium Compounds

Plant	Location	Products	Wastes potentially generated
Harshaw Filtrol	Solon, Ohio	Thallium (I) bromide Thallium (I) chloride Thallium (I) iodide	U216

Reference: SRI 1989.

The production process currently used to manufacture the three thallium salts being produced is proprietary. However, in the past, all thallium compounds were generally made from thallic sulfate (thallium (III) sulfate, $Tl_2(SO_4)_3$), which had been recovered as a byproduct of the production of cadmium metal. Thallic sulfate was generally reduced to thallous sulfate (thallium (I) sulfate, Tl_2SO_4) and then converted to the carbonate. The carbonate was then reacted with the appropriate mineral acid to manufacture the desired thallous salt (Mellor 1946). Until about 10 years ago, thallic sulfate was sold primarily as a rodenticide. This use has largely disappeared, and the product has been replaced by other non-thallium-containing, nonpersistent pesticides.

2.2 Waste Characterization

A very limited amount of waste characterization information is available. According to the 1986 National Survey of Hazardous Waste

Treatment, Storage, Disposal, and Recycling Facilities (TSDR Survey), only six facilities reported generating thallium-containing wastes (USEPA 1986a). Table 2-2 lists the generators and the amounts of U-code and P-code thallium-containing wastes generated by each facility. Table 2-3 shows the amounts of thallium-bearing wastes reportedly received by commercial waste treatment and disposal firms in 1986. Most of this quantity was reported to be obsolete thallic sulfate rodenticide requiring proper disposal.

Waste composition data were available from the 1986 National Survey of Hazardous Waste Generators (Generator Survey) for the waste from only one facility (USEPA 1986b). This waste contained 75 to 90 percent thallium, which is typical for a discarded laboratory chemical. U-code and P-code wastes are generally discarded, spilled, or off-specification chemicals.

No waste generation was reported by the one facility manufacturing thallium salts. Wastes from that facility's processes are discharged to a local publicly-owned treatment works (POTW) system (Versar 1989). Production volumes are less than one ton per year.

2.3 Determination of Waste Treatability Groups

In some cases EPA believes that wastes with different waste codes, produced in similar processes in an industry or in similar industries, can be treated to similar concentrations using the same technologies. In these instances, the Agency may combine the codes into a single treatability group.

Based on careful review of the generators of thallium-containing wastes and available waste characterization data, the Agency has determined that thallium nonwastewaters comprise two treatability groups

Table 2-2 Estimated Quantities of RCRA P-Code and U-Code Thallium Wastes Generated in 1986

RCRA P or U waste	Thallium waste generator	Estimated quantity generated in 1986 (pounds)	Comments
P113	Aldrich Chemical Co.	9	1 gallon waste reported (assume 9 lb/gal density); research quantity.
P113	Argonne National Lab.	270	30 gallons waste reported (assume 9 lb/gal); research quantity.
P114	E.I. DuPont Co.	1	Research quantity.
P115	Aldrich Chemical Co.	9	1 gallon waste reported (assume 9 lb/gal); research quantity.
P115	E.I. DuPont Co.	1	Research quantity.
P115	TRW Electronics & Defense	20	Actual thallium content not known; assume 1% of P115 in material.
P115	TRW Electronics & Defense	60	6,000 lb of electroplating waste mixture including D004, F007, P030, P038, P064, P106, and P115; assume only trace (0.1%) of P115 in the mixture.[a]
P115	USAF Norton AFB	810	90 gallons of waste reported (assume 9 lb/gal).
	Total P-code thallium waste generated	1,180	

Table 2-2 (continued)

RCRA P or U waste	Thallium waste generator	Estimated quantity generated in 1986 (pounds)	Comments
U214	Aldrich Chemical Co.	9	1 gallon waste reported (assume 9 lb/gal); research quantity.
U215	Aldrich Chemical Co.	9	1 gallon waste reported (assume 9 lb/gal); research quantity.
U215	E.I. DuPont Co.	1	Research quantity.
U216	Aldrich Chemical Co.	9	1 gallon of waste reported (assume 9 lb/gal); research quantity.
U216	Argonne National Lab.	27	3 gallon of waste reported (assume 9 lb/gal); research quantity.
U217	Aldrich Chemical Co.	9	1 gallon of waste reported (assume 9 lb/gal); research quantity.
U217	American Cyanamid	10	110 gallons of waste reported as mixture of P001, U204, and U217 (assume 9 lb/gal and 1% U217).[a]
U217	E.I. DuPont Co.	5	Research quantity.
	Total U-code thallium waste generated	79	
	Total P- and U-code thallium waste generated	1,259	

[a] Assumptions based on telephone conversations between Versar Inc. personnel and the generating plants.

Reference: USEPA 1986a.

Table 2-3 Estimated Quantities of RCRA P-Code and U-Code Thallium Wastes Received by TSDR Facilities in 1986

RCRA P or U waste	Thallium waste handler	Estimated quantity handled in 1986 (pounds)	Comments
P116	Casmalia Resources	40,000	This material consists of obsolete rodenticides (mixtures of thallium sulfate and inert materials) that are being phased out by suppliers of these materials and thus would not be a continuing source of this waste.[a]
P216	Appropriate Technologies II	10	None.
	Total P-code thallium waste handled	40,010	
U214	ThermalKem	45	5 gallons of waste reported (assume 9 lb/gal).
U214	Earth Industrial Waste	2	None.
	Total U-code thallium waste handled	47	
	Total P-code and U-code thallium waste handled	40,057	

[a] This information is based on a telephone conversation between Versar Inc. and Casmalia Resources.

Reference: USEPA 1986a.

and thallium wastewaters represent a single treatability group. The P-code and U-code thallium-containing nonwastewaters are expected to be similar in terms of the constituents that they contain. All of these wastes are inorganic thallium compounds. P114 also contains selenium. Therefore, different treatment technologies may be applicable for treatment of nonwastewater forms of this waste. P114 nonwastewaters thus represent a separate treatability group. All P-code and U-code thallium wastewaters contain a similar inorganic constituent, thallium, in an inorganic matrix and are, therefore, expected to be treatable to similar levels using the same technology. None of the thallium U and P wastes are expected to be routinely generated containing organic constituents.

3. APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

Section 2 established three treatability groups for the management of thallium-containing wastes. This section identifies the treatment technologies that are applicable to these groups and determines which, if any, of the applicable technologies can be considered demonstrated for the purpose of establishing BDAT.

To be applicable, a technology must be theoretically usable to treat the waste in question or to treat a waste that is similar in terms of the parameters that affect treatment selection. (For detailed descriptions of the technologies applicable for these wastes, or for wastes judged to be similar, see EPA's Treatment Technology Background Document (USEPA 1989b).) To be demonstrated, the technology must be employed in full-scale operation for the treatment of the waste in question or a similar waste. Technologies available only at pilot- and bench-scale operations are not considered in identifying demonstrated technologies.

3.1 Applicable Treatment Technologies

Initial data gathering on the treatment of thallium-containing wastes included review of the technical literature and contacts with industry representatives. As a result of these efforts, EPA has identified three technologies as potentially applicable for treatment of these wastes.

3.1.1 Treatment Technologies for Nonwastewaters

(1) Thermal recovery. Thermal recovery technologies are applicable to the recovery of thallium from wastes. In high-temperature metals recovery, the waste is heated in a reducing atmosphere to vaporize the metal. Thallium has a boiling point of 1460°C. The vaporized metal usually reacts with air to form an oxide, which is recovered from

the air stream exiting the high-temperature recovery unit. High temperature metals recovery is discussed in the Treatment Technology Background Document (USEPA 1989b).

(2) **Stabilization**. Thallic oxide (Tl_2O_3) and thallic hydroxide ($Tl(OH)_3$) wastes (such as wastewater treatment sludges generated from chemical precipitation treatment of thallium-containing wastewaters) may be treated by stabilization. Stabilization involves mixing of the insoluble thallium compounds with lime and fly ash, concrete, cement, or other pozzolanic materials and water. Chemical reactions occur in the mixed materials, which then cure into a hard concrete-like mass. Stabilization technologies are discussed in the Treatment Technology Background Document (USEPA 1989b).

Chemical precipitation and chemical oxidation are also applicable to nonwastewaters. However, these are primarily wastewater treatment technologies and will be discussed in the following section (3.1.2). To use these technologies for treatment of many nonwastewaters, the waste must first be either dissolved or suspended in water.

3.1.2 Treatment Technologies for Wastewaters

Both chemical precipitation and chemical oxidation are applicable to wastewaters.

(1) **Chemical precipitation**. Chemical precipitation is a technology used for treatment of dissolved metals in wastewaters. In chemical precipitation treatment, chemicals are added to the waste solution, resulting in the formation of insoluble compounds that can be physically separated by technologies such as sedimentation and filtration.

Chemical precipitation of thallium as insoluble thallic hydroxide, by addition of lime or caustic to an aqueous solution or suspension of the

waste, converts all soluble thallic salts present into highly insoluble thallic hydroxide ($Tl(OH)_3$). Chemical precipitation is discussed in detail in the Treatment Technology Background Document (USEPA 1989b).

(2) Chemical oxidation. Thallium in wastewaters occurs in two oxidation states-monovalent thallous (or thallium (I)) salts and trivalent thallic (or thallium (III)) salts. As a general rule, thallous compounds are much more soluble than thallic compounds. Thus thallium is more easily removed from wastewaters when it is in the thallic form. Thallous salts may be oxidized to thallic compounds by aqueous chemical oxidation processes using a variety of oxidizing agents. Chemical oxidation processes are aqueous treatment processes that are usually used to destroy organic or oxidizable inorganic constituents in wastewaters. These processes can also be used, however, to convert a metal from a low oxidation state to a higher oxidation state. Hydrogen peroxide, potassium permanganate, and sodium hypochlorite all oxidize thallous salts to thallic compounds for this reaction (Mellor 1946). Sodium hypochlorite is reported to be completely effective at room temperature (Mellor 1946). Chemical oxidation is discussed in the Treatment Technology Background Document (USEPA 1989b).

3.2 Demonstrated Treatment Technologies

3.2.1 Demonstrated Treatment Technologies for Nonwastewaters

Thermal recovery, stabilization, chemical oxidation, and chemical precipitation are all full-scale, well-demonstrated technologies that have been used for management of a wide variety of BDAT list metal-containing wastes. Use of chemical oxidation or precipitation for treatment of many nonwastewaters requires that the waste first be dissolved or suspended in water.

3.2.2 Demonstrated Treatment Technologies for Wastewaters

Chemical oxidation and chemical precipitation are full-scale, well-demonstrated wastewater treatment methods used for removal of BDAT list metal ions from wastewaters. These technologies are therefore demonstrated for wastes similar to P an U thallium wastewaters.

4. PERFORMANCE DATA BASE

This section normally presents the data available to EPA on the performance of demonstrated technologies in treating the listed wastes. However, EPA does not have treatment data on either wastewater or nonwastewater forms of the subject thallium wastes. Eligible data, in addition to full-scale demonstration data, would include data developed at research facilities or obtained through other applications at less than full-scale operation, as long as the technology is demonstrated in full-scale operation for a similar waste or wastes as defined in Section 3.

Where data are not available on the treatment of the specific wastes of concern, as is the case with thallium wastes, the Agency may elect to transfer data on the treatment of a similar waste or wastes, using a demonstrated technology. To transfer data from another waste category, EPA must find that the wastes covered by this background document are no more difficult to treat (based on the waste characteristics that affect performance of the demonstrated treatment technology) than the treated wastes from which performance data are being transferred.

Table 2-3 listed the amounts of wastes containing thallium received by TSDR facilities in 1986. The facility receiving most of the material, Casmalia Resources, is a hazardous waste landfill. It did not treat the waste prior to disposal. The other facilities received very small quantities of thallium-bearing wastes and mixed them with other wastes prior to treatment. As a result, treatment data on thallium-containing nonwastewaters are not available.

As noted in Section 3, the treatment technologies demonstrated on thallium waste are thermal recovery and stabilization for nonwastewaters and chemical oxidation and chemical precipitation for wastewaters.

The Agency does have extensive data on stabilization as applied to nonwastewater forms of other BDAT list metal-containing wastes. These data are provided in the F006 background document (USEPA 1988a), as well as other BDAT program background documents.

Additional wastewater treatment data, primarily from EPA's Office of Water, have been analyzed for the development of concentration-based treatment standards for thallium-containing wastewaters. Further information on these data, including the sources of the data and the treatment technologies used, can be found in the Preamble to the Third Third Land Disposal Restrictions Proposed Rule and in the Best Demonstrated Available Technology (BDAT) Background Document for Wastewaters Containing BDAT List Constituents (USEPA 1989d). Data on treatment of other BDAT list metal-containing wastewaters by chemical precipitation and chemical oxidation are given in the effluent guidelines background document for the inorganic chemicals industry (USEPA 1982).

5. IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section presents the Agency's rationale for determining best demonstrated available technology (BDAT) for nonwastewater and wastewater forms of thallium-containing wastes.

To determine BDAT, the Agency examines all available performance data on technologies that are identified as demonstrated to determine (using statistical techniques) whether one or more of the technologies performs significantly better than the others. The technology that performs best on a particular waste or waste treatability group is then evaluated to determine whether it is "available." To be available the technology must (1) be commercially available to any generator and (2) provide "substantial" treatment of the waste, as determined through evaluation of accuracy-adjusted data. In determining whether treatment is substantial, EPA may consider data on the performance of a waste similar to the waste in question provided that the similar waste is at least as difficult to treat. If the best technology is found to be not available, then the next best technology is evaluated, and so on.

The most desirable waste management technology is one that results in no residual streams or a residual stream with no hazardous properties. However, no such technologies have been identified for thallium-containing wastes. The best technology identified for nonwastewaters is a combination of chemical oxidation, chemical precipitation, and stabilization conducted in series. In this approach, the waste may have to be dissolved or slurried with water prior to chemical treatment. This approach first converts all thallium compounds present to the thallium (III) oxidation state and then precipitates thallium compounds as insoluble thallic hydroxide. Stabilization treatment of the wastewater treatment sludge residual thus generated is expected by EPA to reduce the leachability of thallium even further. Thus, chemical oxidation followed

by chemical precipitation and stabilization is the "best" technology for treatment of thallium nonwastewaters. These technologies are commercially available and are expected to result in significant reduction of thallium leachate concentration. Therefore, the Agency has determined that this approach as BDAT.

For wastewaters, the Agency believes that chemical oxidation of thallium (I) to thallium (III) followed by chemical precipitation of thallium by conventional hydroxide precipitating agents (e.g., lime or sodium hydroxide) will reduce the concentration of thallium in wastewaters. The Agency has identified chemical oxidation and precipitation as thallic hydroxide as the best technology for treatment of these wastes. Chemical oxidation and chemical precipitation are technologies that are commercially available and are expected to provide significant treatment of thallium; hence, these technologies represent BDAT for thallium wastewaters.

6. SELECTION OF REGULATED CONSTITUENTS

EPA is proposing treatment standards for thallium in both wastewaters and nonwastewaters for all the P- and U-code thallium wastes covered by this background document. Thallium is the only Appendix VIII constituent for which these wastes are listed (except for P114, which is discussed below) and is the only BDAT list constituent that the Agency expects to find in these wastes on a regular basis (unless these wastes are mixed with other listed hazardous wastes, in which case other treatment standards would also apply).

P114 contains both thallium and selenium as BDAT list constituents. This waste is also being regulated as a selenium-containing waste. Treatment standards for selenium in P114 are discussed in the proposed Best Demonstrated Available Technology (BDAT) Background Document for Arsenic and Selenium (USEPA 1989c), which is also being developed for this proposed rulemaking.

7. DEVELOPMENT OF BDAT TREATMENT STANDARDS

The proposed BDAT treatment standard for nonwastewater forms of P113, P115, U214, U215, U216, and U217 is recovery or stabilization as a method of treatment. The proposed BDAT treatment standard for P114 nonwastewaters is vitrification or stabilization as a method of treatment. The proposed treatment standard for the wastewater forms of P113, P114, P115, U214, U215, U216, and U217 is chemical oxidation of thallium (I) compounds followed by chemical precipitation with hydroxide compounds, settling, and filtration. The proposed treatment standard for these wastewaters is 0.14 mg/l, measured as total composition of a 24-hour composite sample. These treatment standards are summarized in Tables 7-1 and 7-2.

Table 7-1 Proposed BDAT Treatment Standards for P113, P114, P115, U214, U215, U216, and U217 Nonwastewaters

Waste code	Proposed treatment standard
P113, P115, U214, U215, U216, U217	RECOVERY OR STABILIZATION AS A METHOD OF TREATMENT
P114[a]	VITRIFICATION OR STABILIZATION AS A METHOD OF TREATMENT

[a] Also see the Best Demonstrated Available Technology (BDAT) Background Document for K031, K084, K101, K102, characteristic arsenic wastes (D004), characteristic selenium wastes (D010), and P and U wastes containing arsenic and selenium listing constituents (USEPA 1989c) for selenium treatment standard for P114.

Table 7-2 Proposed BDAT Treatment Standards for P113, P114, P115, U214, U215, U216, and U217 Wastewaters

Regulated constituent	Maximum for any single 24-hour composite sample Total composition (mg/l)
Thallium	0.14

[a] Also see the Best Demonstrated Available Technology (BDAT) Background Document for K031, K084, K101, K102, characteristic arsenic wastes (D004), characteristic selenium wastes (D010), and P and U wastes containing arsenic and selenium listing constituents (USEPA 1989c) for selenium treatment standard for P114.

8. REFERENCES

ACHA, AWWA, and WPCF. 1985. American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Standard methods for the examination of water and wastewater. 16th ed. Washington, D.C.: American Public Health Association.

Mellor, J.W. 1946. A comprehensive treatise on inorganic and theoretical chemistry. Volume 5, pp. 434-463. London: Longmans Green.

SRI. 1989. Stanford Research Institute. 1989 Directory of chemical producers, United States of America. Menlo Park, California: Stanford Research Institute.

U.S. Bureau of Mines. 1988. 1987 Minerals yearbook. Volume I: Metals and minerals. Washington, D.C.: U.S. Bureau of Mines.

USEPA. 1982. U.S. Environmental Protection Agency, Office of Solid Waste and Hazardous Materials. Development document for effluent limitations guidelines and pretreatment standards for the inorganic chemicals manufacturing point source category. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1986a. U.S. Environmental Protection Agency. 1986 National survey of hazardous waste treatment, storage, disposal and recycling facilities. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1986b. U.S. Environmental Protection Agency. 1986 National survey of hazardous waste generators. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988a. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for F006. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988b. U.S. Environmental Protection Agency, Office of Solid Waste. Generic quality assurance project plan for Land Disposal Restrictions Program ("BDAT"). Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989a. U.S. Environmental Protection Agency, Office of Solid Waste. Methodology for developing BDAT treatment standards. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989b. U.S. Environmental Protection Agency, Office of Solid Waste. Treatment technology background document. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989c. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for arsenic and selenium: proposed. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989d. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for wastewaters containing BDAT list constituents. Washington, D.C.: U.S. Environmental Protection Agency.

Versar. 1989. Documentation of telephone communication between E. Rissmann, Versar Inc. and J. Berish, Harshaw Filtrol, Solon, Ohio.